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I, JONNE YABSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PP 9850 for a patent by USF FILTRATION AND SEPARATIONS GROUP INC. as filed on 20 April 1999.

WITNESS my hand this
Fourteenth day of February 2003

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PATENTS ACT 1990

PROVISIONAL SPECIFICATION

FOR THE INVENTION ENTITLED:-

" MEMBRANE FILTRATION MANIFOLD SYSTEM"

The invention is described in the following statement:-

TECHNICAL FIELD

The present invention relates to membrane filtration manifold systems. More particularly, the invention relates to membrane filtration manifold systems for hollow fibre membrane filters comprising elongate bundles of hollow fibre membranes, wherein feed to be filtered is fed to the outside of the bundles of fibres and filtrate is extracted from the end or ends of the fibre lumens. The systems also preferably incorporate a cleaning facility for periodic cleansing of the feed surfaces of the fibres.

The invention has been developed primarily for use in a membrane filtration system which is open to atmospheric pressure and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular field of use.

BACKGROUND ART

Typical prior art filtration manifolds are employed in filtration systems of the type described above. These filtration systems generally include elongate tubular cartridges enclosing a bundle of the hollow fibre membranes. Manifold or header arrangements are used to connect the cartridges, usually at one or both ends, these manifolds acting to separate and divert the respective flows of the contaminated feed, filtrate and cleaning fluid through the system. In this regard, cross-flow systems typically have two feed manifolds (inlet and re-circulation outlet) and one or two filtrate manifolds. In cross-flow filtration systems of the prior art the feed stream to be filtered flows tangential to or across the surface of the membrane. This generates a sweeping action at the membrane surface, keeping the surface cleaner. Conversely, systems

configured for dead end operations utilise only one feed inlet manifold and one filtrate outlet manifold during filtration mode. Further, these prior art manifolds or header arrangements are often configured to facilitate the construction of modular two or three dimensional cartridge arrays.

Most typically, the prior art filtration systems, as previously described, are closed to the atmosphere. In such systems, fluid to be filtered, hereinafter referred to as feed, is fed under positive pressure to the filters. In order for this type of system to operate effectively, the elongate tubular filtration cartridges are encased in pressure tight housings. Such housings are then connected to a manifold system which both separates the feed from the filtrate and supports the pressure tight housing. The manifold system may also serve to introduce cleaning fluid to the filtration system.

Prior art filtration systems, as previously described, may also be open to the atmosphere. Typically in such systems, feed is drawn through the membranes under negative pressure. This is achieved by applying a negative, or suction, pressure on the filtrate side of the membrane. Such systems tend to employ less infrastructure and capital works compared with systems closed to the atmosphere as they do not require components that are able to contain relatively higher pressures. For example, there is no need to encase filtration cartridges in individual pressure tight housings in systems open to atmosphere. Typically in these systems, the filtration cartridges are merely substantially immersed in an open tank containing the feed. In such systems it is desirable that an appropriate manifold be provided to both support the filter cartridges and to allow the filtrate to be drawn from the filter while separating the feed from the filtrate. Similarly, as with closed systems, such a manifold may also serve the purpose

of supporting a cleaning fluid system.

Prior art filtration systems and their associated filtration cartridges referred to above are often a complex configuration of pipes and parts which are difficult and time consuming to assemble. Further more, the actual manifold system components of the prior art filtration systems are often a complex assembly of parts in themselves.

The prior art filtration systems described above also require regular testing to assess system integrity. Non-integrity may be due to failure of individual filtration membrane hollow fibres, 'o'-rings or other system components. Integrity testing often requires the removal of either individual system components or filtration cartridges. This removal is often difficult in typical prior art filtration manifolds. Furthermore, as previously discussed, typical prior art filtration manifolds may contain many complex parts. It then follows that integrity testing of these parts can also be time consuming.

It is an object of the present invention to provide a filtration manifold system of the kind herein described which overcomes or ameliorates at least some of the deficiencies of the prior art or at least offers a useful alternative thereto.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a membrane filtration manifold for connecting a filter submodule of the kind comprising one or more elongate bundles of hollow fibre membranes, said manifold including:

a housing connected with at least one submodule connecting collar;

said collar being adapted to receive and locate said submodule having a connecting sleeve with a locking formation whereby the submodule can be secured at

one end with the collar by a clip means adapted to simultaneously engage said module and said locking formation to prevent axial withdrawal of said submodule from said collar.

Preferably, said locking formation includes a circumferential flange formed on said sleeve.

Also, in a preferred form, the housing and collars of the manifold include passageways for fluid communication between the housing and collars. Further preferably, the housing includes a removable cap for fluid-tight sealing engagement with the housing.

According to a second aspect of the invention there is provided a membrane filtration apparatus including a headpiece and a basepiece each being a membrane filtration manifold according to the first aspect of the invention, said headpiece further adapted for connection to a filtrate conduit allowing fluid communication between said headpiece and said filtrate conduit and said basepiece further adapted for connection to a cleaning fluid conduit allowing fluid communication between said basepiece and said cleaning fluid conduit.

According to a third aspect of the invention there is provided a membrane filtration apparatus bank including a plurality of membrane filtration apparatus according to the second aspect of the invention wherein each said headpiece is connected to a filtrate conduit and each said basepiece is connected to a cleaning fluid conduit.

Preferably, the module groups are arranged in an upright position, said filtrate conduit being proximally above said headpieces and said cleaning fluid conduit being proximally above said basepieces.

According to a fourth aspect of the invention there is provided a membrane filtration apparatus array including a plurality of membrane filtration apparatus banks according to the third aspect of the invention wherein each of said filtrate conduits is connected to an array filtrate conduit.

According to another aspect of the invention there is provided a membrane filtration array train including a plurality of membrane filtration apparatus arrays according to the fourth aspect of the invention wherein said array filtrate conduits are connected by a train conduit such that said filtrate conduits are in fluid communication with said train conduits.

BRIEF DESCRIPTION OF THE FIGURES

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a membrane filtration manifold according to the invention;

Figure 2 is another perspective view of the membrane filtration manifold of Figure 1;

Figure 3 is a sectional view showing a submodule connected to a manifold collar by a locking clip;

Figure 4a is an isometric view of the preferred embodiment of the clip;

Figure 4b is an isometric view of the preferred embodiment of the clip of Figure 4a;

Figure 5 is a cross sectional side elevation of the locking clip of Figure 4a;

Figure 6a is a detail view of the collar;

Figure 6b is another detail view of the collar;

Figure 7a is a plan view of an embodiment of the connecting sleeve for filtration modules;

Figure 7b is a sectional view of the connecting sleeve of Figure 8a taken on line A-A of Figure 7a;

Figure 7c is a side elevation of the connecting sleeve of Figure 7a;

Figure 8a is a plan view of an alternate embodiment of the connecting sleeve for filtration modules;

Figure 8b is a sectional view of the connecting sleeve of Figure 8a taken on line B-B of Figure 8a;

Figure 8c is a side elevation of the connecting sleeve of Figure 8a;

Figure 9a is a perspective view of a cap;

Figure 9b is another perspective view of the cap of Figure 9a;

Figure 10 is a perspective view of the membrane filtration manifold of Figure 1 showing the cap of Figure 9a in use;

Figure 11 is a side elevation of a membrane filtration apparatus bank;

Figure 12a is a side cross sectional elevation of an embodiment of the membrane filtration manifold in basepiece configuration, showing cleaning fluid flow from the cleaning fluid conduit through the basepiece;

Figure 12b is a front cross sectional elevation of an embodiment of the membrane filtration manifold in basepiece configuration, showing cleaning fluid flow from the cleaning fluid conduit through the basepiece;

Figure 13 is a plan view of a membrane filtration apparatus array;

Figure 14 is a perspective view showing one membrane filtration apparatus bank in a membrane filtration apparatus array; and

Figure 15 is an isometric view of a membrane filtration apparatus train.

PREFERRED EMBODIMENTS OF THE INVENTION

Referring to the drawings, the membrane filtration manifold system includes a membrane filtration manifold 1 for connecting filter submodules 2 of the kind comprising elongate bundles of hollow fibre membranes. As best shown in Figures 1 and 2, the preferred embodiment of the manifold includes a housing 3 connected with four module connecting collars 4.

Referring to Figure 3, the collars 4 are adapted to receive and locate submodules 2 having a connecting sleeve 5 with a locking flange 6. In this embodiment, the submodule 2 can be secured at one end with its respective collar 4 by a clip 7 which simultaneously engages the submodule 2 and locking flange 6 to prevent axial withdrawal of the submodule 2 from the collar 4. The locking flange 6 further engages bearingly with a lip 8 of the collar 4. Engaging and releasing the clip 7 enables substantially simple respective assembly and removal of the submodules 2 from the manifold 1. The manifold 1 further includes filtrate passageways 9 for fluid communication between the housing 3 and collars 4 and cleaning fluid passageways 10 for cleaning fluid communication with a cleaning fluid conduit 11.

Figures 4a to 6b show the preferred embodiment of the clip 7. The clip 7 has a substantially cylindrical sidewall 12 with a top and bottom flange 13 and 14, each of

which projects radially inwardly from the sidewall 12. The clip 7 is split in a line parallel to the central axis of the submodule 2 to allow radial expansion of the clip when slid axially into and out of locking engagement with the collar 4. Radial expansion is achieved by manually parting a pair of projections 40 provided on the top flange 13 of the clip, on either side of the split respectively. Furthermore, the clip 7 is resiliently biased to enable radial contraction of the clip when the clip simultaneously snap-lockingly engages with the submodule 2 and collar 4. When the clip is employed to simultaneously engage the submodule and the locking flange, bottom flange 14 locks over the submodule flange 6 and top flange 13 bearingly engages with the lip 8. Furthermore, the collar 4 has a stepped seat 15 for locking engagement with top flange 13.

Figures 7a-c and 8a-c show embodiments of the submodule connection sleeves 5. These Figures show detail of the flange 6 and 'o'-ring seat channel 17 features of the connection sleeves 5. One side 18 of the flange 6 is for bearing engagement with the collar 4 and a second side 19 is for locking engagement with the clip 7. Further, the embodiment of the submodule connection sleeve 5 shown in Figures 7a-c, has one channel 17 for use as an 'o'-ring seat, while the embodiment of the submodule connection sleeve 5 shown in Figures 8a-c, has two channels 17 for use as 'o'-ring seats.

The manifold 1 may also include a removable cap 20, for fluid-tight sealing engagement with the housing. The preferred embodiment of the cap, shown in Figures 9a and 9b, includes a disc 21 with an axially extending threaded shaft 22 mounted to its centre. In use, the shaft 22 is threadedly engaged with a corresponding bore (not shown)

in the manifold 1. The cap 20 is manually threadedly engaged to the manifold using projections 23 extending axially outwardly from the cap. These projections 23 are on the side of the disc opposite to that of the shaft 22.

A radially spaced flange 24 extends axially outwardly from the cap 20 on the same side of the cap as the shaft 22. This flange allows fluid tight sealing engagement of the cap 20 with the housing 1. Figure 10 shows the preferred embodiment of the cap 20 in use.

In another embodiment of the invention shown in Figure 11, a membrane filtration apparatus 25 includes a headpiece 26 and a basepiece 27, each being the membrane filtration manifold 1 as described above, and connected to four membrane filter submodules 2. Each headpiece 26 connects to a filtrate conduit 28 allowing fluid communication between each headpiece 26 and the filtrate conduit 28. When the membrane filtration manifold 1 is used as a headpiece 26, the cap 20 is removed from the manifold 1. This removal allows fluid communication between the manifold 1 and the filtrate conduit 28. Further, as seen particularly in Figures 12a and 12b, each basepiece 27 is connected to a cleaning fluid conduit 11 allowing fluid communication between each basepiece 27 and the cleaning fluid conduit 11. When the membrane filtration manifold 1 is used as a basepiece 27, the cap 20 remains connected to the manifold 1.

In another embodiment of the invention, a membrane filtration apparatus bank 29 includes a plurality of membrane filtration apparatus 25 as described above wherein each headpiece 26 is connected to a filtrate conduit 28 and each basepiece 27 is connected to a cleaning fluid conduit 11. Additional stiffening elements 30, as shown in Figure 11,

may also be provided therebetween to aid physical stability of the filtration system. Typically, there are eight membrane filtration apparatus 25 in each bank 29 and the membrane filtration apparatus are arranged in an upright position. When employed in a filtration system, the bank 29 is substantially immersed in the feed, where the feed is contained in a tank 31 with an open top.

Preferably, air is used as the filtration submodule cleaning fluid which flows through the cleaning fluid conduit 11. As best shown in Figures 11, 12a and 12b, the cleaning fluid conduit 11 is proximally above the basepieces 27 and lies in a straight line along the length of the bank 29 in between the collars 4. This allows the cleaning fluid conduit 11 to supply air to the basepieces 27 through a plurality of passageways 10 on the under side of the cleaning fluid conduit 11. Supplying air to the basepieces 27 through the underside of the cleaning fluid conduit 11 allows controlled release of the cleaning air, ensuring it is evenly distributed along the entire length of the bank 29.

In another embodiment of the invention, the filtration system includes a membrane filtration apparatus array as shown in Figures 11 and 13 having a plurality of apparatus banks 29 wherein each of the filtrate conduits 28 are connected to an array filtrate conduit 32.

The filtration apparatus banks 29 are further adapted for relatively simple disconnection from the membrane filtration apparatus array. When disconnected, the filtration apparatus banks may be removed from the membrane filtration apparatus array by lifting the bank vertically from the array. Similarly, the banks may also be placed individually into an array by lowering the banks vertically into its predetermined position. This allows for less complicated assembly and disassembly of the arrays and

convenient access to submodules disposed in or near the centre of the array.

In a further embodiment of the invention, a membrane filtration array train, as best shown in Figure 15, includes a plurality of membrane filtration apparatus arrays from Figure 14 wherein the array filtrate conduits 32 are connected by a train conduit 33 such that the array filtrate conduits 32 are in fluid communication with the train conduits 33.

During filtration the tanks 31 are continuously substantially filled with feed which in turn submerges the arrays of filter submodules 2. Pumps 34 draw the feed through the filter submodules 2 producing filtrate. The filtrate under negative pressure from the pumps 34, travels through the manifolds 1, via the filtrate conduits 28, array filtrate conduits 32, and train filtrate conduits 33 and on to the pump. The filtrate then leaves the pump and also the filtration system via a filtrate exit conduit 35.

Although the invention has been described with reference to specific examples and to filtration manifolds used in filtration systems open to atmosphere, it will now be appreciated by those skilled in the art that the invention may be embodied in many other forms including filtration manifolds used in filtration systems closed to atmosphere.

DATED this 20th Day of April, 1999

USF FILTRATION AND SEPARATIONS GROUP INC.

Attorney: PETER R. HEATHCOTE
Fellow Institute of Patent Attorneys of Australia
of BALDWIN SHELSTON WATERS

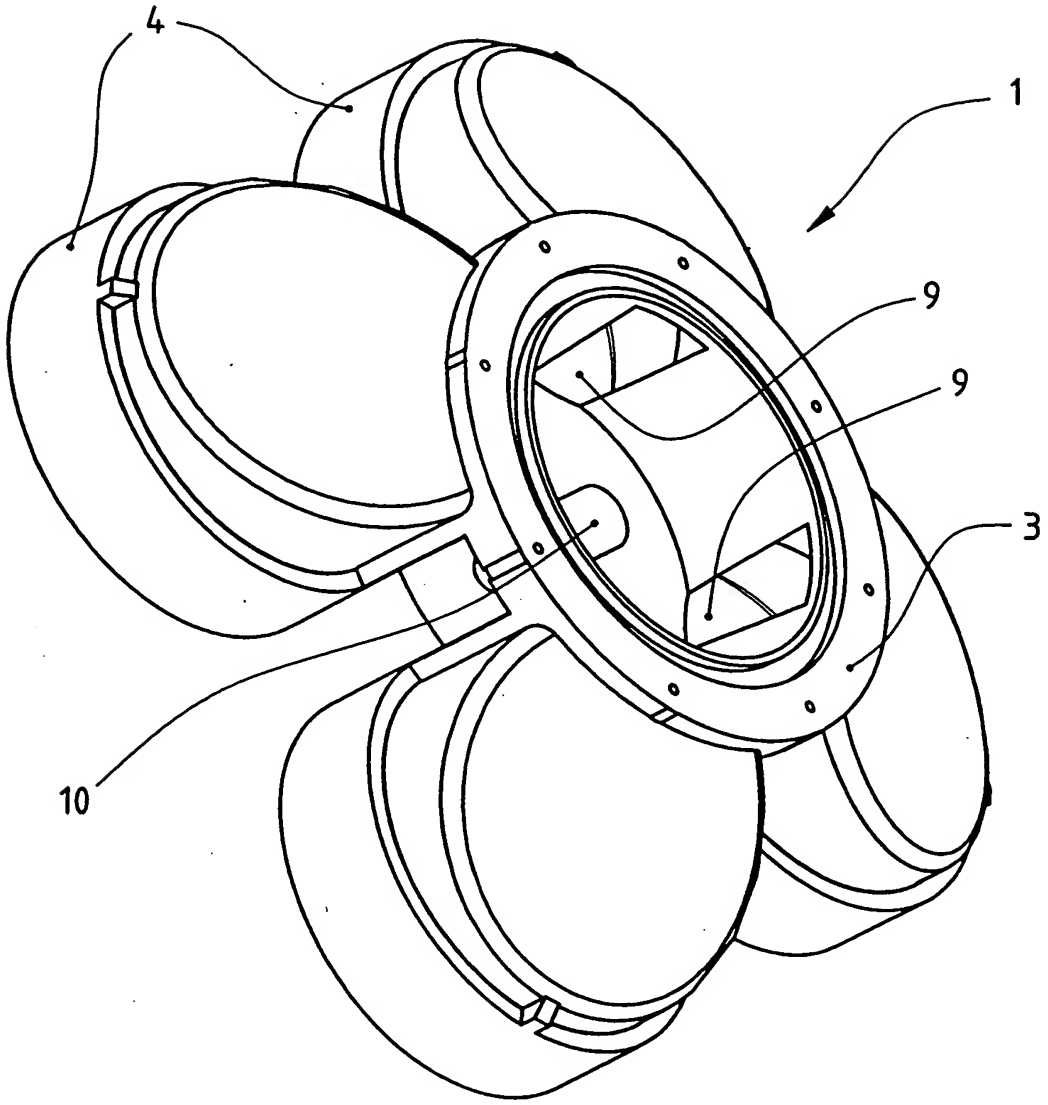

FIG 1

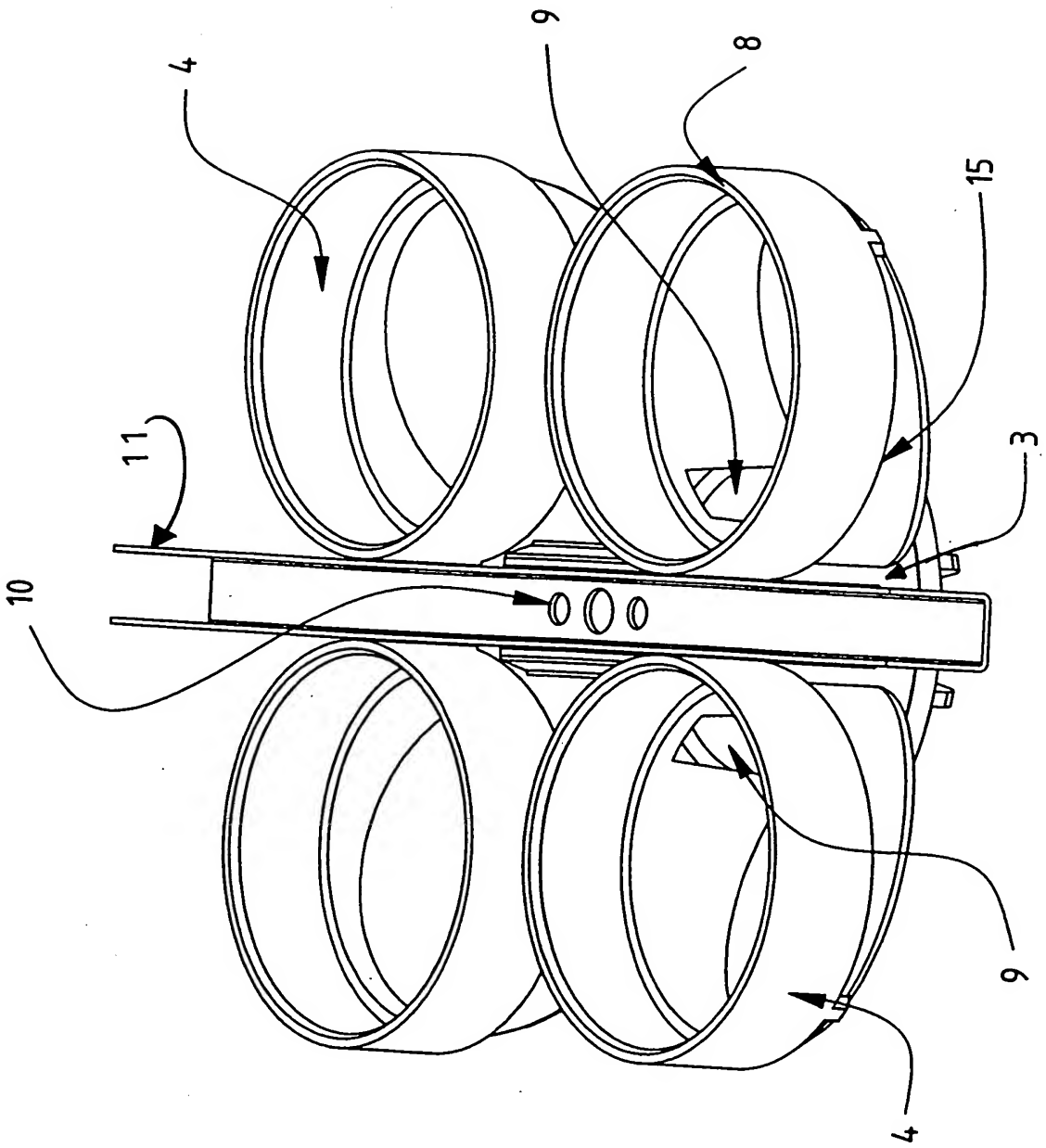

FIG 2

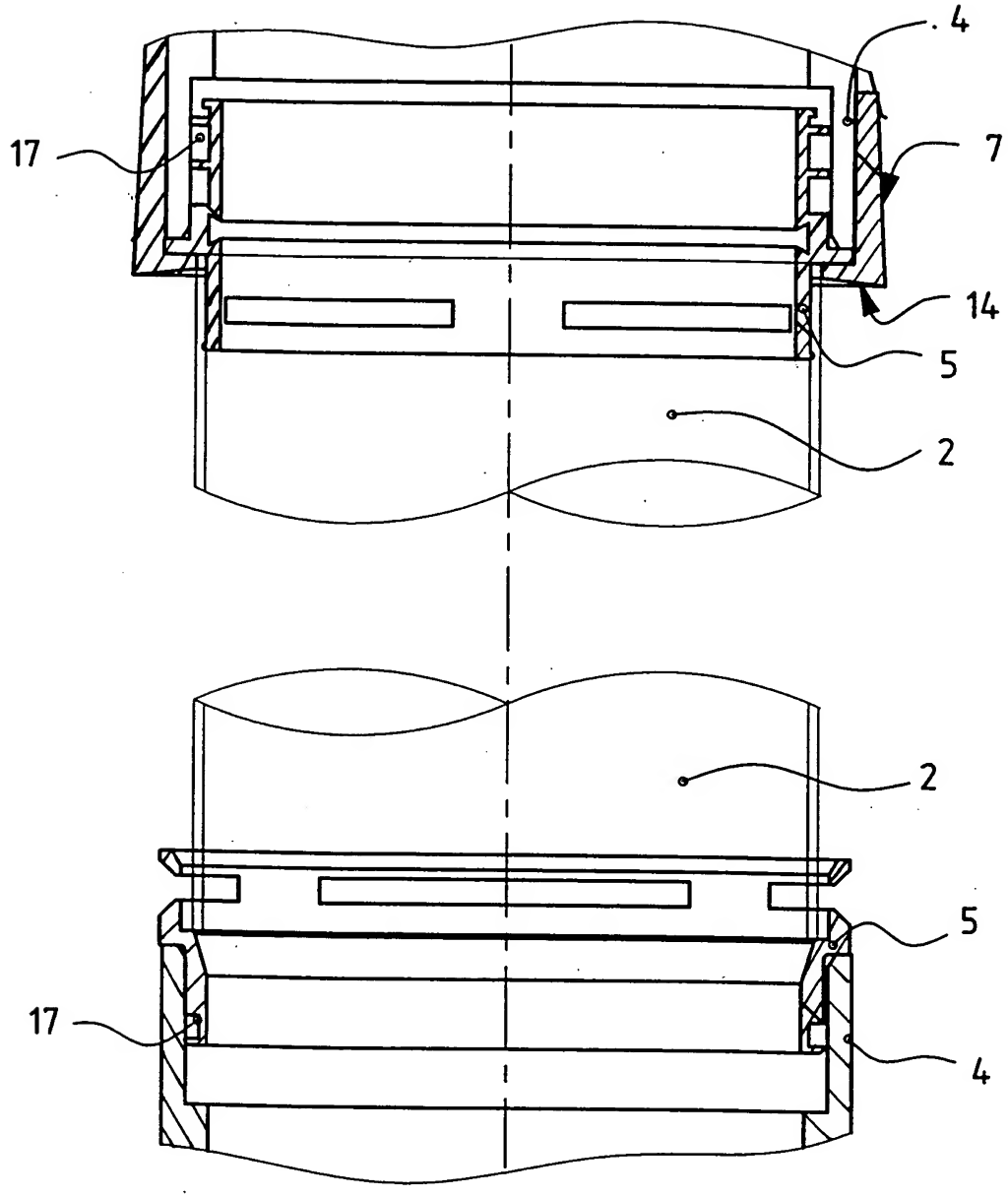

FIG 3

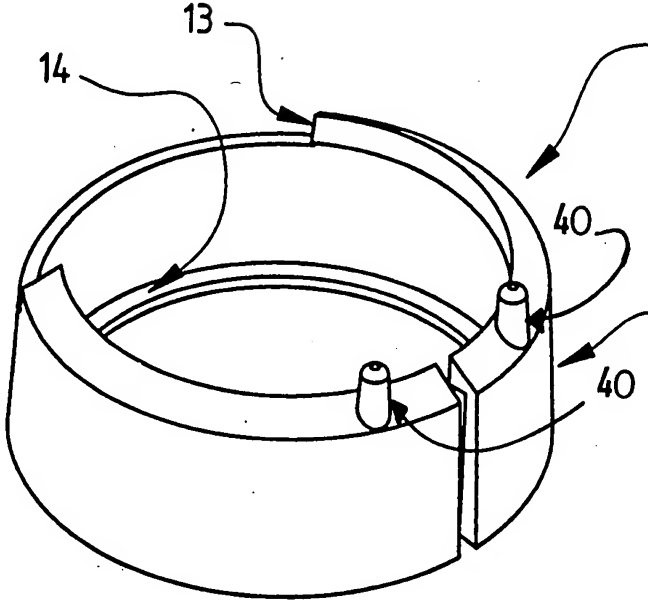

FIG 4a

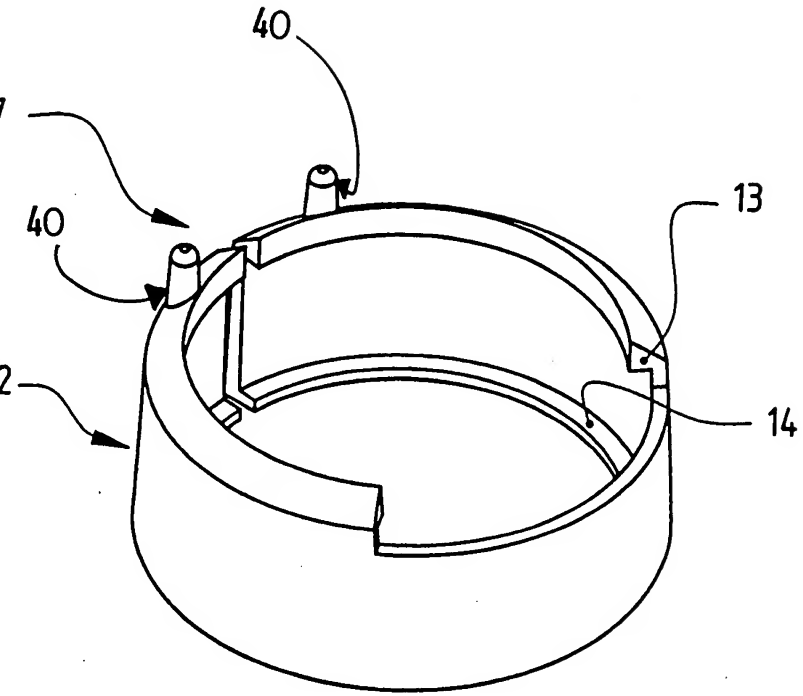

FIG 4b

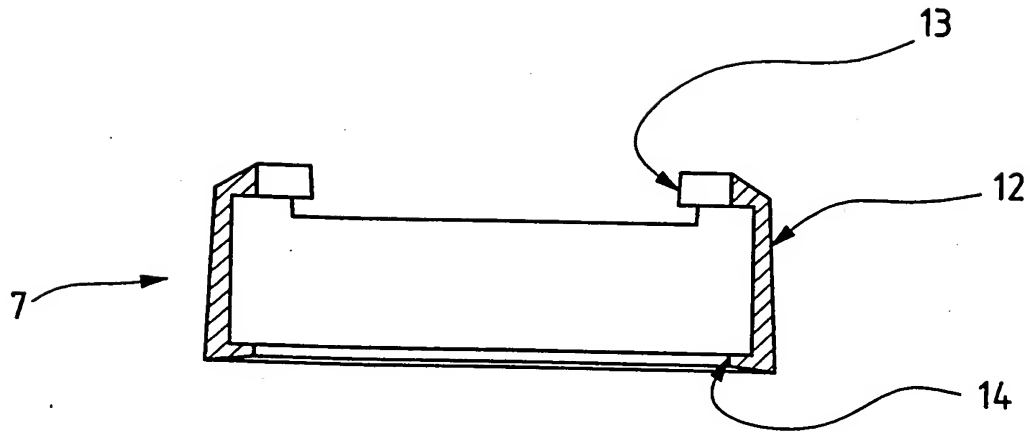

FIG 5

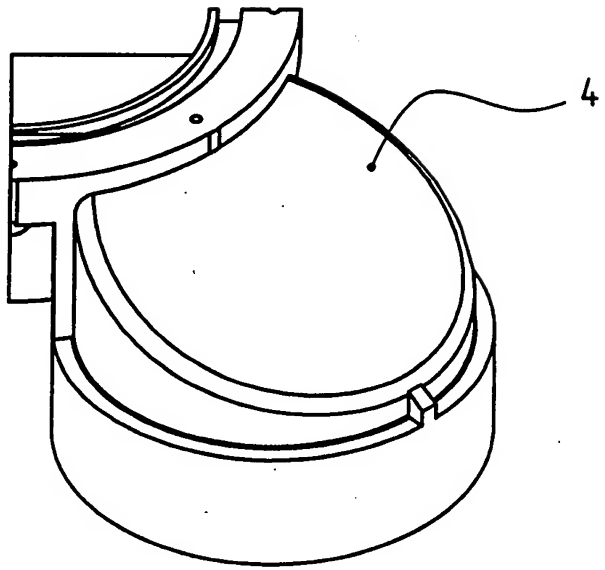

FIG 6a

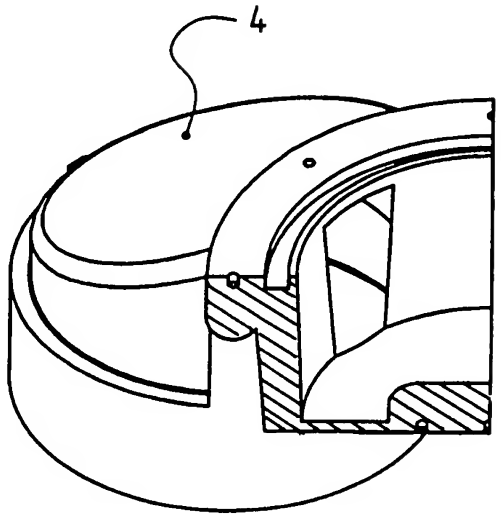

FIG 6b

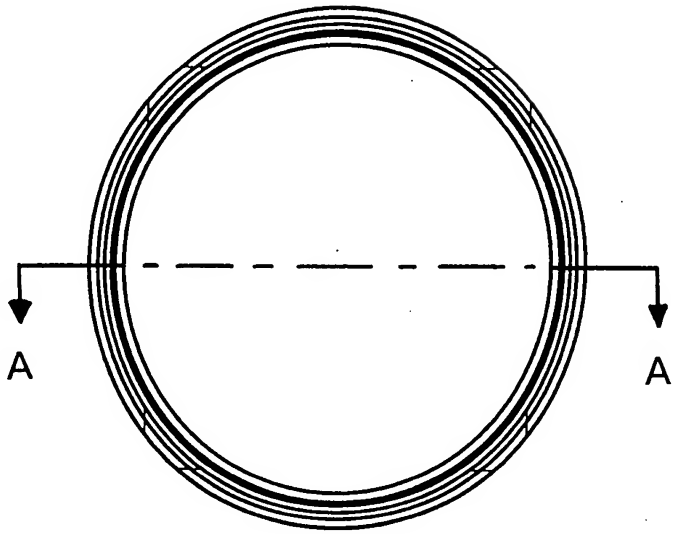

FIG 7a

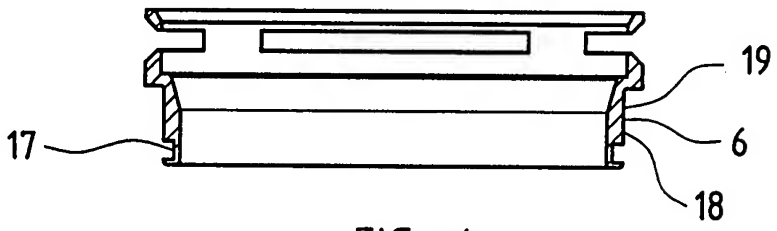

FIG 7b

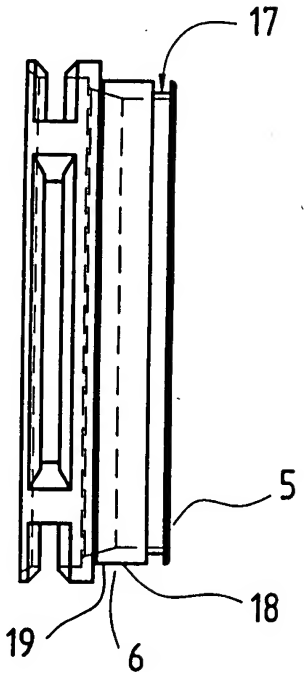

FIG 7c

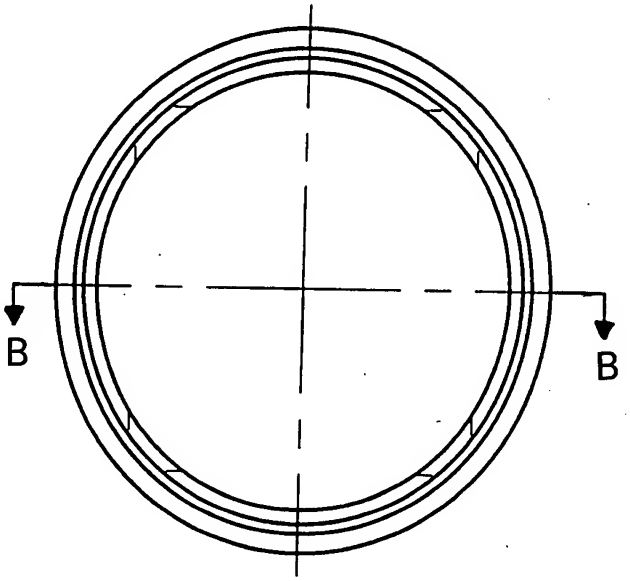

FIG 8a

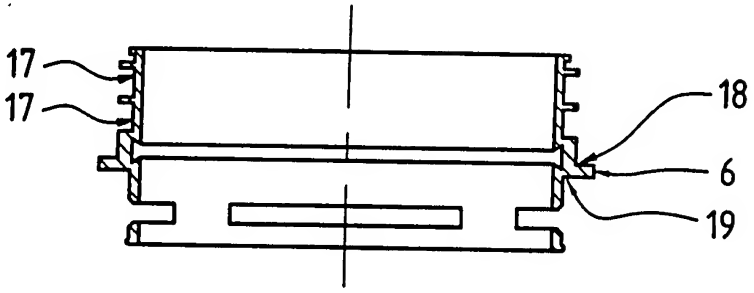

FIG 8b

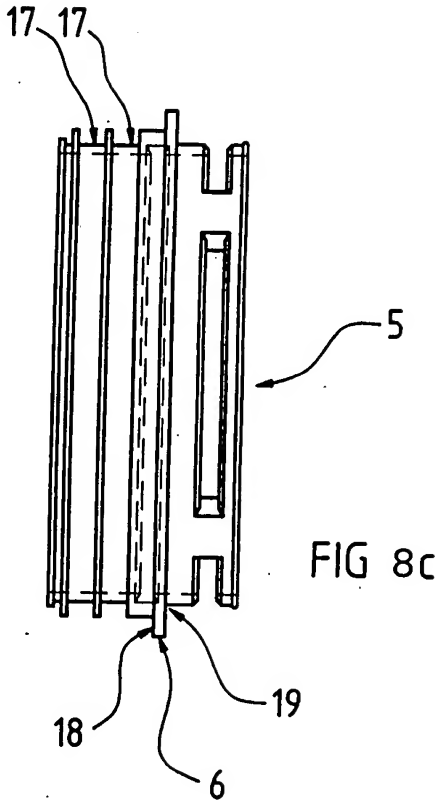

FIG 8c

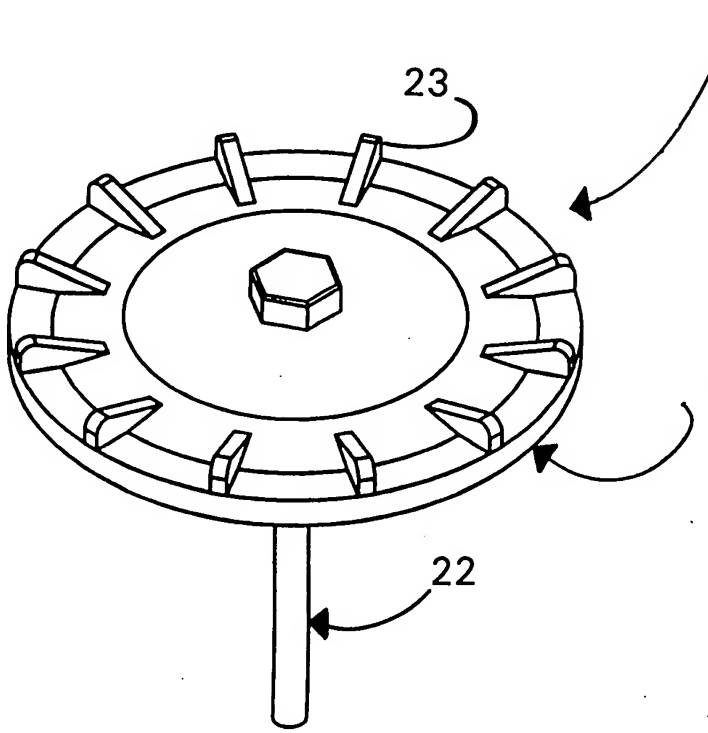

FIG 9a

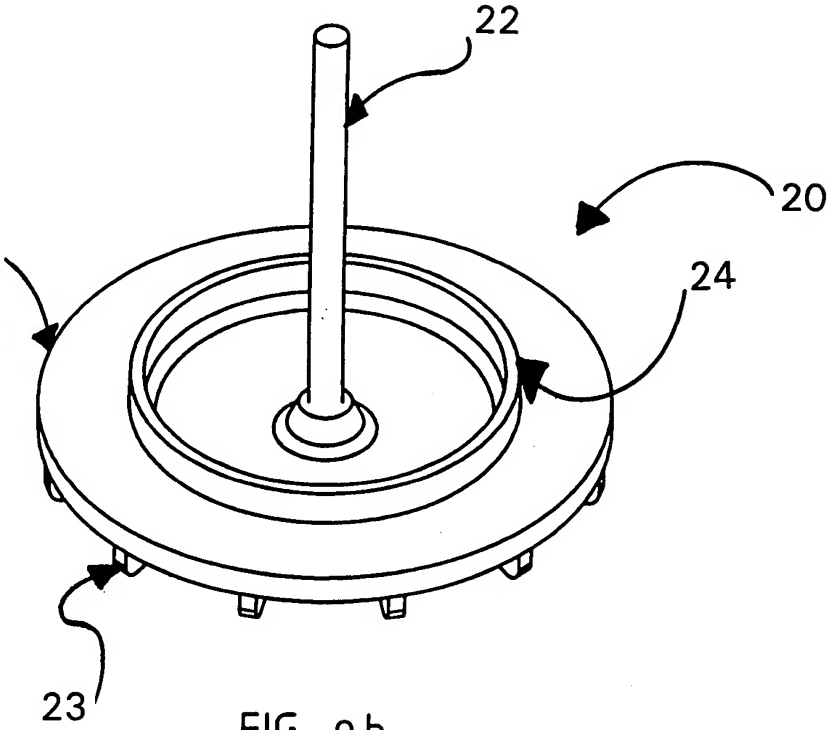

FIG 9b

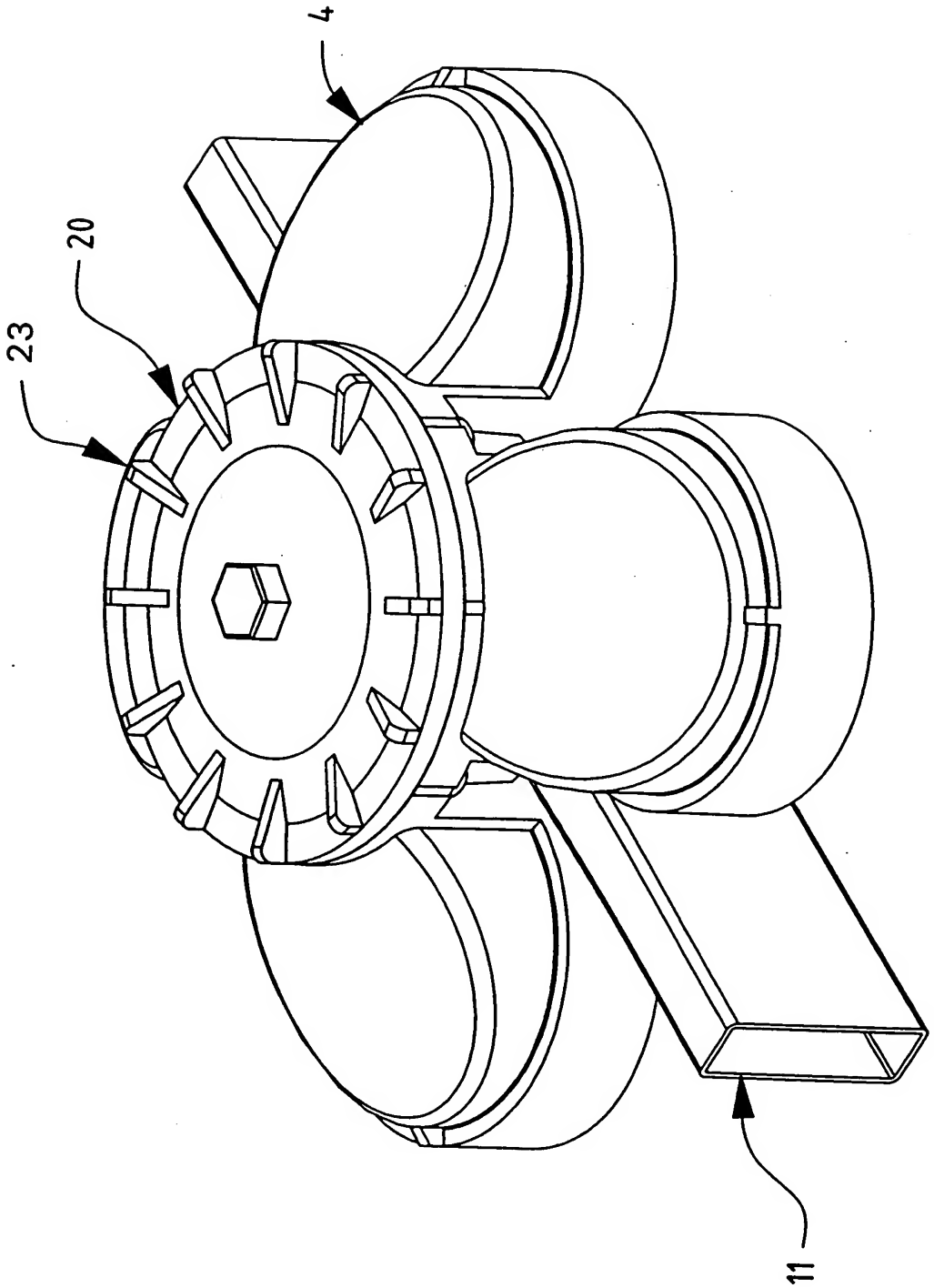

FIG 10

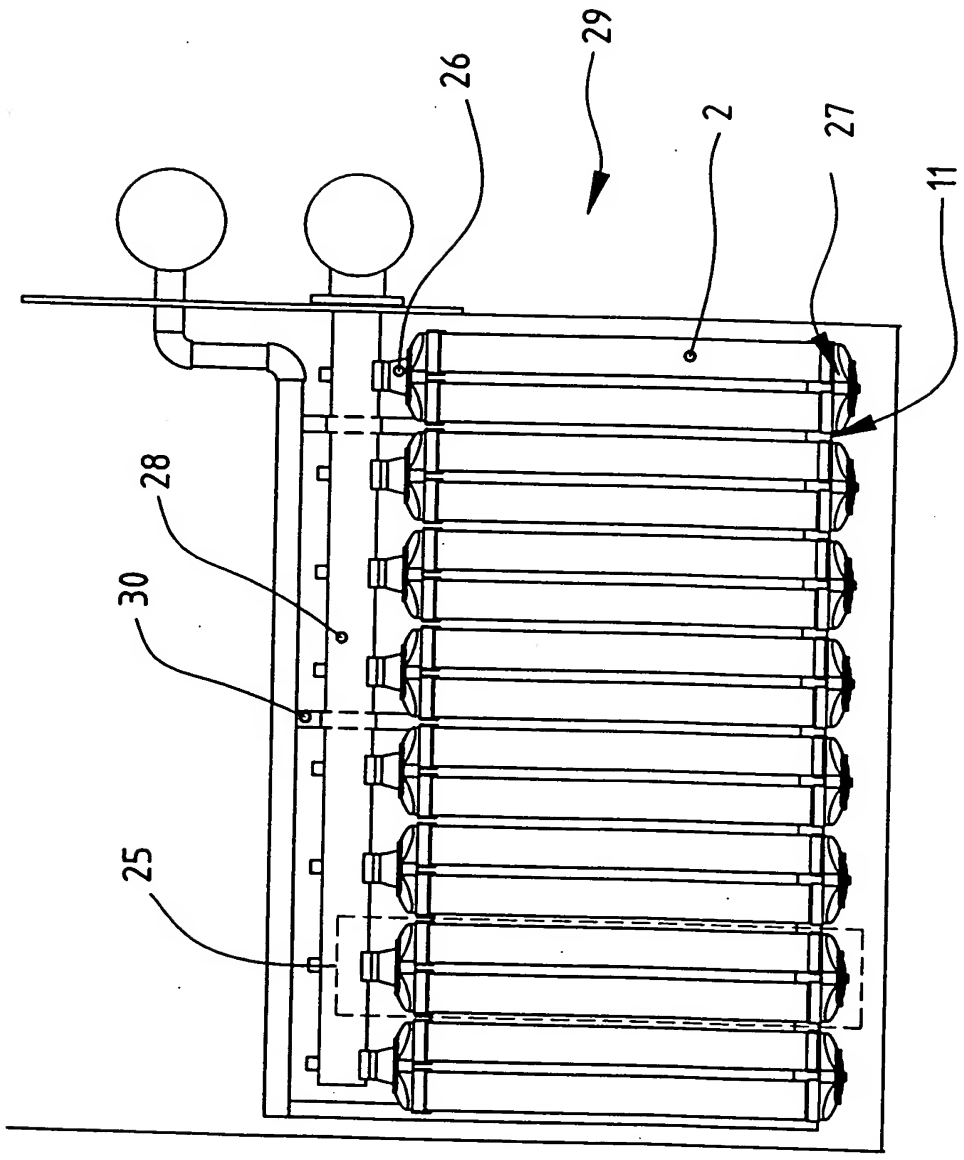

FIG 11

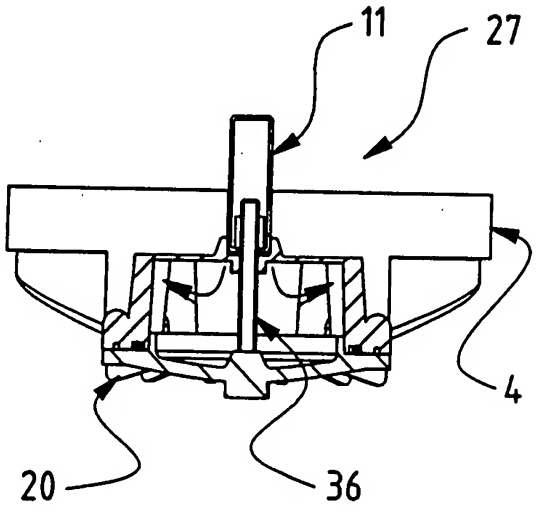

FIG 12a

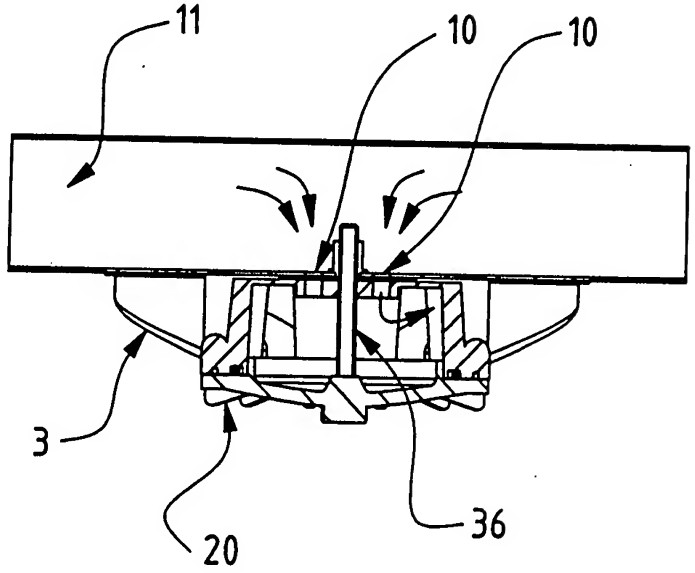

FIG 12b

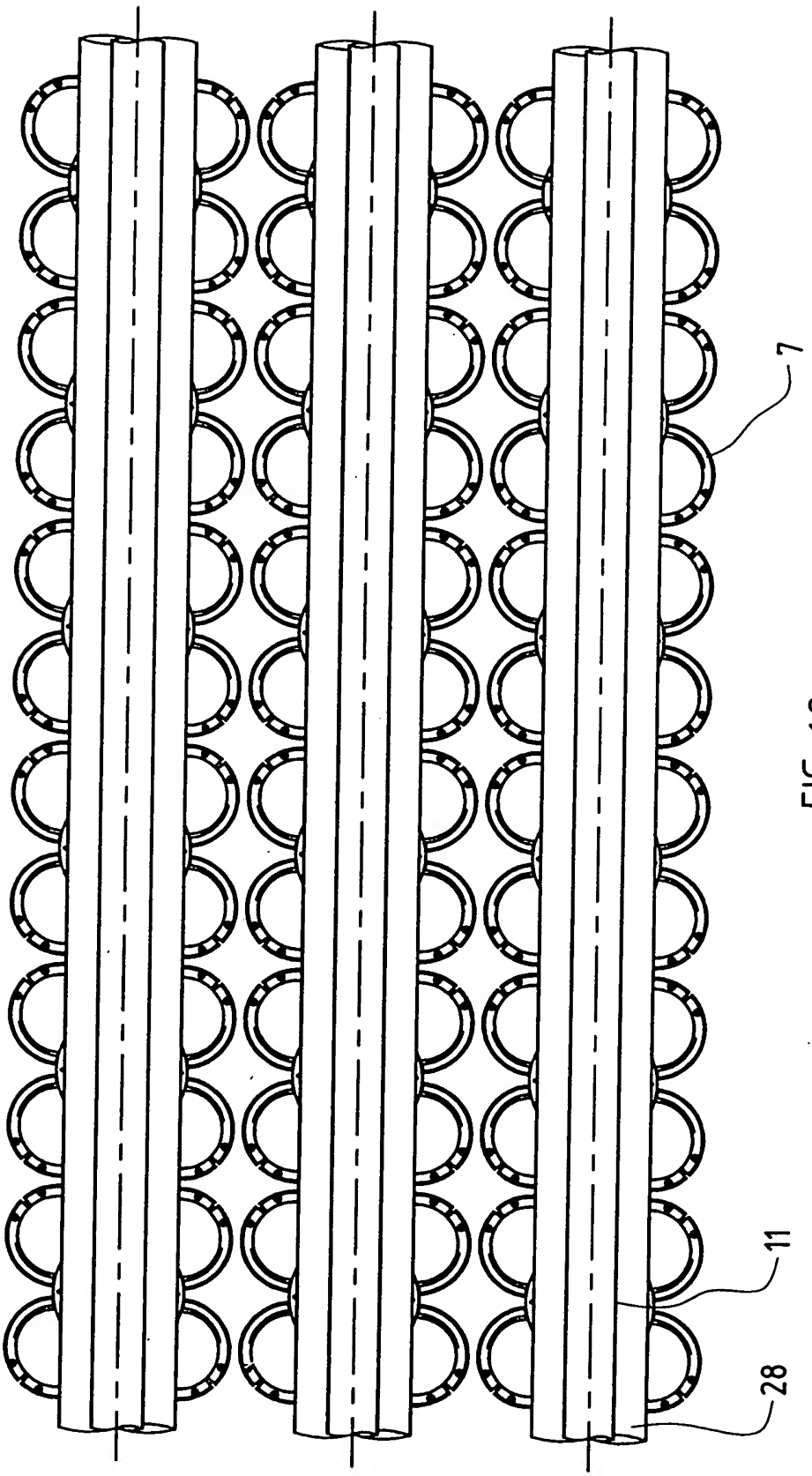

FIG 13

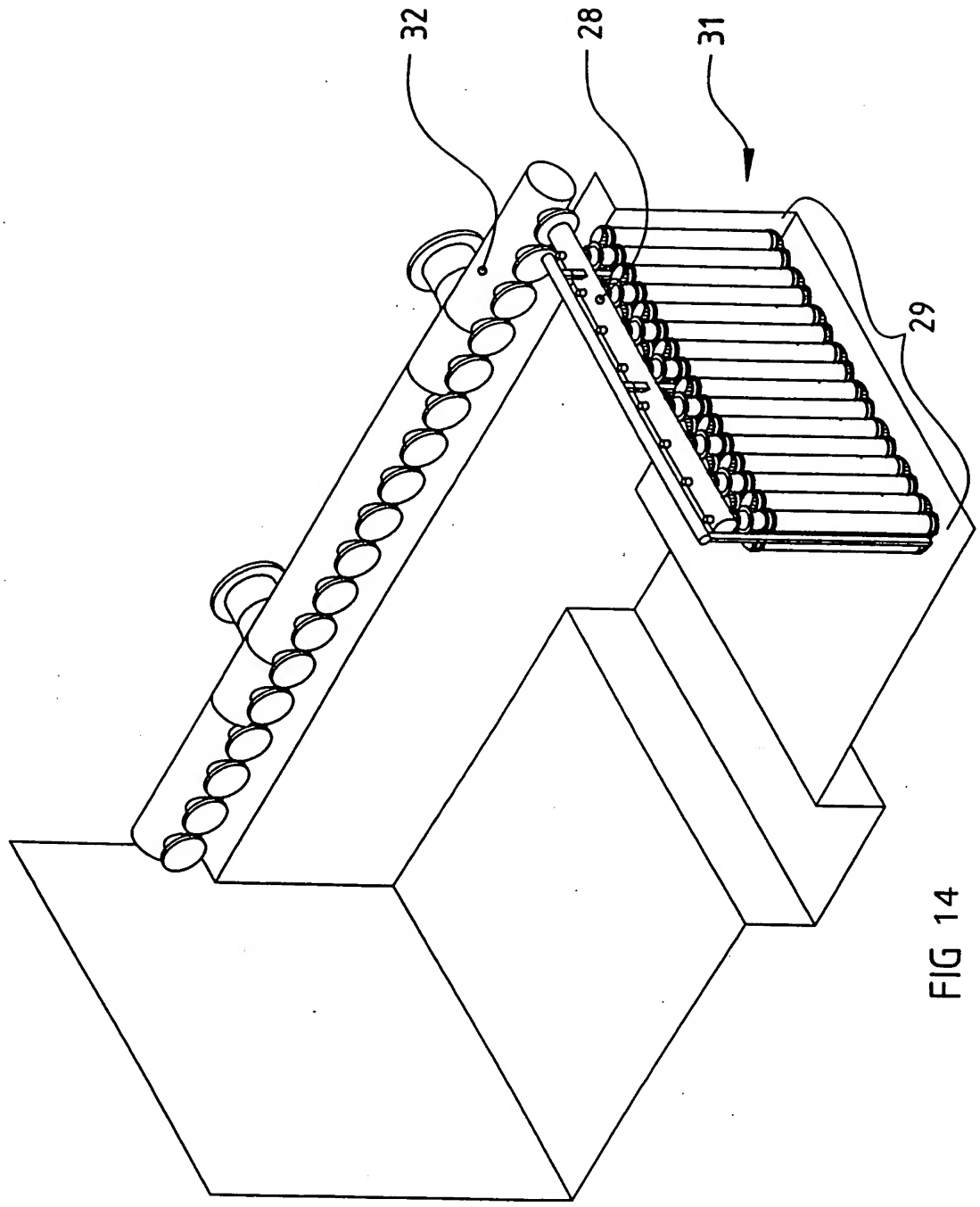

FIG 14

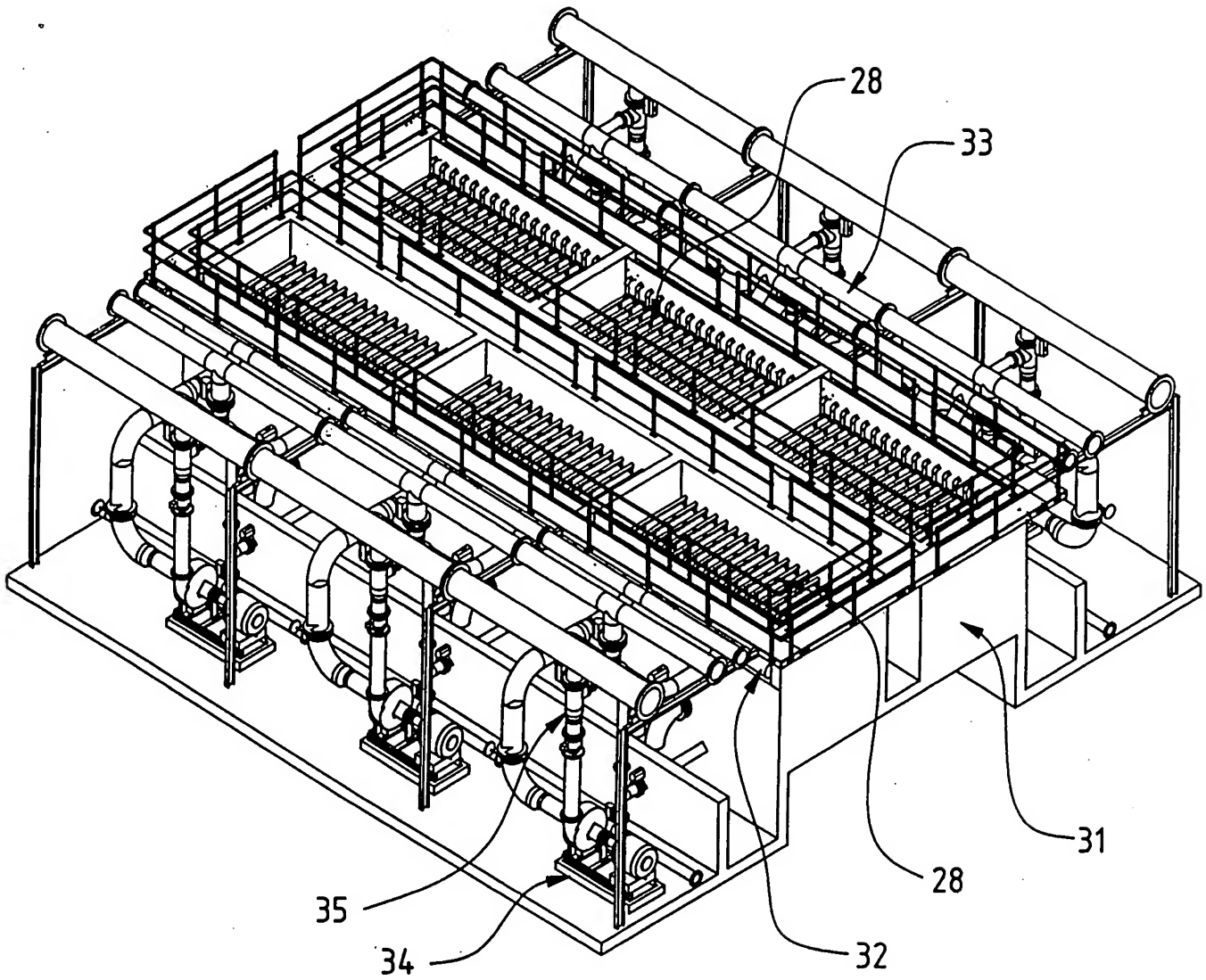

FIG 15